What is claimed is:

1. A direct sequence spread spectrum radio frequency (RF) modem, comprising:

a pulse generator adapted to generate a pulse from an Intermediate Frequency (IF) oscillator signal having an IF frequency, said pulse generator comprising a first pulse shaping circuit adapted to shape the contour of said pulse;

a pulse spreader adapted to spread said shaped pulse with a spreading code sequence waveform so as to generate a spread pulse;

a transmitter circuit including an upconverter for mixing said spread pulse with a local oscillator (LO) signal having an LO frequency so as to generate a spread spectrum transmission signal at an RF frequency;

a receiver circuit including a downconverter for mixing a received signal with said LO signal so as to generate a received spread pulse at said IF frequency;

a correlator adapted to de-spread said received spread pulse in accordance with said code sequence so as to generate a correlator signal; and

a detector adapted to generate an output signal in response to said correlator signal.

2. The modem according to claim 1, wherein said IF oscillator signal and said LO signal are generated by an oscillator circuit adapted to utilize a single frequency source.

3. The modem according to claim 2, wherein said oscillator circuit comprises:

said frequency source;

a first frequency doubler connected to said frequency source; and

a second frequency doubler connected to the output of said first frequency doubler.

4. The modem according to claim 2, wherein said frequency source comprises a surface acoustic wave (SAW) resonator.

5. The modem according to claim 2, wherein said frequency source comprises a surface acoustic wave (SAW) resonator tuned to 488 MHz.

6. The modem according to claim 1, wherein:

a single surface acoustic wave (SAW) resonator is adapted to generate said IF oscillator signal and said LO oscillator signal;

said pulse spreader and said correlator share the same surface acoustic wave (SAW) correlator adapted to be used half duplex for transmission and receiving; and wherein said SAW resonator and said SAW correlator are constructed on the same monolithic substrate.

7. The modem according to claim 1, wherein said IF frequency is 488 MHz.

8. The modem according to claim 1, wherein said LO frequency is 1952 MHz.

9. The modem according to claim 1, wherein said RF frequency is adapted to be in the 2.4 GHz Industrial Scientific Medial (ISM) band of frequencies.

10. The modem according to claim 1, wherein said pulse generator comprises a gating mechanism for gating said IF oscillator signal in accordance with input data to be transmitted.

11. The modem according to claim 1, further comprising a switching mechanism adapted to gate the output of said pulse generator and the output of said pulse spreader in an inverse relationship to each other, whereby when said pulse generator is enabled, said pulse spreader output is not and vice versa.

12. The modem according to claim 1, wherein said pulse spreader comprises second pulse shaping means operative to smooth the transitions of said spread pulse.

13. The modem according to claim 1, wherein said first pulse shaping circuit adapted to generate said pulse contour comprising a first portion that linearly ramps the amplitude of said pulse from a low to a high value and a second portion that linearly ramps the amplitude of said pulse from a high to a low value.

14. The modem according to claim 1, wherein said pulse spreader comprises a surface acoustic wave (SAW) matched filter.

15. The modem according to claim 1, wherein said spreading code sequence comprises a Barker code series sequence.

16. The modem according to claim 1, wherein said spreading code sequence comprises a 13-chip Barker sequence {1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1}.

17. The modem according to claim 1, wherein said transmitter circuit comprises:

an IF amplifier for amplifying said spread pulse;
said upconverter for mixing said spread pulse with a LO signal;
an RF power amplifier for amplifying said spread spectrum transmission signal; and
an antenna coupled to the output of said output RF power amplifier.

18. The modem according to claim 1, wherein said receiver circuit comprises:
an antenna adapted to receive RF signals;
a first low noise amplifier (LNA) coupled to said antenna;
said downconverter for mixing said received signal with said LO oscillator signal; and
a second low noise amplifier for amplifying the output of said downconverter.

19. The modem according to claim 1, wherein said correlator means comprises a surface acoustic wave (SAW) matched filter/correlator.

20. The modem according to claim 19, wherein said SAW matched filter/correlator is configured with a Barker code series sequence.

21. The modem according to claim 20, wherein said Barker code series sequence comprises a 13-chip Barker sequence {1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1}.

22. The modem according to claim 1, wherein said spreading means and said correlator means share a surface acoustic wave (SAW) correlator adapted to be used half duplex for transmission and receiving.

23. The modem according to claim 1, wherein said detector comprises:
a slow peak detector adapted to generate a slowly varying reference signal in accordance with said correlator signal;
a fast peak detector adapted to track the envelope of said correlator signal and to generate a detection signal therefrom; and
a decision circuit adapted to generate said output signal by comparing said detection signal against said reference signal.

24. A method of modulating and demodulating a direct sequence spread spectrum signal, said method comprising the steps of:
generating a pulse from an Intermediate Frequency (IF) oscillator signal having an IF frequency, wherein the contours of said pulse are shaped;

spreading said shaped pulse with a spreading code sequence waveform and generating a spread pulse therefrom;

mixing said spread pulse with a local oscillator (LO) signal having an LO frequency and generating therefrom a spread spectrum transmission signal at an RF frequency;

mixing a received signal with said LO oscillator signal and generating therefrom a received spread pulse at said IF frequency;

de-spreading said spread spectrum transmission signal in accordance with said code sequence and generating a correlator signal therefrom; and

detecting an output signal in response to said correlator signal.

25. The method according to claim 24, wherein said IF oscillator signal and said LO signal are generated utilizing a single frequency source.

26. The method according to claim 24, wherein said IF frequency is 488 MHz.

27. The method according to claim 24, wherein said LO frequency is 1952 MHz.

28. The method according to claim 24, wherein said RF frequency is adapted to be in the 2.4 GHz Industrial Scientific Medial (ISM) band of frequencies.

29. The method according to claim 24, wherein said step of generating a pulse comprises gating said IF oscillator signal in accordance with input data to be transmitted.

30. The method according to claim 24, further comprising the step of gating the output of said pulse generator and the output of said pulse spreader in an inverse relationship to each other, whereby when said pulse is generated, said spread pulse is not and vice versa.

31. The method according to claim 24, wherein said step of spreading comprises the step of smoothing the transitions of said spread pulse whereby the frequency content of said spread pulse is reduced.

32. The method according to claim 24, wherein said step of shaping said pulse comprises shaping said pulse such that the amplitude of said pulse in a first portion is linearly ramped from a low to a high value, and in a second portion the pulse amplitude is linearly ramped from a high back to a low value.

33. The method according to claim 24, wherein said spreading code sequence comprises a Barker code series sequence.

34. The method according to claim 24, wherein said spreading code sequence comprises a 13-chip Barker sequence {1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1}.

35. The method according to claim 24, wherein said step of spreading and de-spreading share the same surface acoustic wave (SAW) correlator adapted to be used half duplex for transmission and receiving.

36. The method according to claim 24, wherein said step of detecting an output signal, comprises the steps of:

generating a slowly varying reference signal in accordance with said correlator signal;

tracking the envelope of said correlator signal and generating a detection signal therefrom; and

generate said output signal by comparing said detection signal against said reference signal.

37. A On/Off Keying (OOK) direct sequence spread spectrum radio frequency (RF) transceiver, comprising:

an input circuit for generating a fixed duration data input signal in accordance with input data to be transmitted; and

an RF modem comprising:

a pulse generator adapted to generate a pulse in response to said data input signal from an Intermediate Frequency (IF) oscillator signal having an IF frequency, said pulse generator comprising a first pulse shaping circuit adapted to shape the contour of said pulse;

a pulse spreader adapted to spread said shaped pulse with a spreading code sequence waveform so as to generate a spread pulse;

a transmitter circuit including an upconverter for mixing said spread pulse with a local oscillator (LO) signal having an LO frequency so as to generate a spread spectrum transmission signal at an RF frequency;

a receiver circuit including a downconverter for mixing a received signal with said LO oscillator signal so as to generate a received spread pulse at said IF frequency;

a correlator adapted to de-spread said spread spectrum transmission signal in accordance with said code sequence so as to generate a correlator signal; and

a detector adapted to generate a data output signal in response to said correlator signal.

38. A Pulse Width Modulation (PWM) direct sequence spread spectrum radio frequency (RF) transceiver, comprising:

an input circuit for generating a pulse width modulated data input signal in accordance with an analog input signal to be transmitted;

an RF modem comprising:

a pulse generator adapted to generate a pulse in response to said data input signal from an Intermediate Frequency (IF) oscillator signal having an IF frequency, said pulse generator comprising a first pulse shaping circuit adapted to shape the contour of said pulse;

a pulse spreader adapted to spread said shaped pulse with a spreading code sequence waveform so as to generate a spread pulse;

a transmitter circuit including an upconverter for mixing said spread pulse with a local oscillator (LO) signal having an LO frequency so as to generate a spread spectrum transmission signal at an RF frequency;

a receiver circuit including a downconverter for mixing a received signal with said LO oscillator signal so as to generate a received spread pulse at said IF frequency;

a correlator adapted to de-spread said spread spectrum transmission signal in accordance with said code sequence so as to generate a correlator signal;

a detector adapted to generate an output signal in response to said correlator signal; and

an output circuit operative to integrate said output signal so as to generate an analog output signal therefrom.

39. A Pulse Position Modulation (PPM) direct sequence spread spectrum radio frequency (RF) transceiver, comprising:

an input circuit for generating a pulse position modulated data input signal in accordance with an analog input signal to be transmitted;

an RF modem comprising:

a pulse generator adapted to generate a pulse in response to said data input signal from an Intermediate Frequency (IF) oscillator signal having an IF frequency, said pulse generator comprising a first pulse shaping circuit adapted to shape the contour of said pulse;

a pulse spreader adapted to spread said shaped pulse with a spreading code sequence waveform so as to generate a spread pulse;

a transmitter circuit including an upconverter for mixing said spread pulse with a local oscillator (LO) signal having an LO frequency so as to generate a spread spectrum transmission signal at an RF frequency;

a receiver circuit including a downconverter for mixing a received signal with said LO oscillator signal so as to generate a received spread pulse at said IF frequency;

a correlator adapted to de-spread said spread spectrum transmission signal in accordance with said code sequence so as to generate a correlator signal;

a detector adapted to generate an output signal in response to said correlator signal; and

an output circuit operative to threshold said output signal against a ramp function so as to generate an analog output signal therefrom.

40. A direct sequence spread spectrum radio frequency (RF) modem, comprising:

an oscillator adapted to generate an Intermediate Frequency (IF) oscillator signal and a Local Oscillator (LO) signal;

a plurality of N transmit/receive circuits, each said transmit/receive circuit comprising:

a pulse generator adapted to generate a pulse from said IF oscillator signal, said pulse generator comprising a first pulse shaping circuit adapted to shape the contour of said pulse;

a pulse spreader adapted to spread said shaped pulse with a spreading code sequence waveform so as to generate a spread pulse;

a correlator adapted to de-spread said spread pulse signal in accordance with said code sequence so as to generate a correlator signal;

a detector adapted to generate an output signal in response to said correlator signal;

wherein the correlator in each transmit/receive circuit is configured with a unique function substantially orthogonal to functions in other correlators;

means for combining and transmitting the N spread pulse signals generated by said N transmit/receive circuits as a combined transmission signal;

a transmitter circuit including an upconverter for mixing said spread pulse with said LO signal so as to generate a spread spectrum transmission signal at an RF frequency;

means for receiving and splitting said combined transmission signal into N receive signals;

a receiver circuit including a downconverter for mixing a received signal with said LO signal so as to generate a received spread pulse at said IF frequency; and

wherein N is a positive integer.

41. The modem according to claim 40, wherein said oscillator comprises:

a frequency source;

a first frequency doubler connected to said frequency source; and

a second frequency doubler connected to the output of said first frequency doubler.

42. The modem according to claim 41, wherein said frequency source comprises a surface acoustic wave (SAW) resonator.

43. The modem according to claim 41, wherein said frequency source comprises a surface acoustic wave (SAW) resonator tuned to 488 MHz.

44. The modem according to claim 40, wherein:

a single surface acoustic wave (SAW) resonator is adapted to generate said IF oscillator signal and said LO oscillator signal;

said pulse spreader and said correlator share the same surface acoustic wave (SAW) correlator adapted to be used half duplex for transmission and receiving; and

wherein said SAW resonator and said SAW correlator are constructed on the same monolithic substrate.

45. The modem according to claim 40, wherein said IF frequency is 488 MHz.

46. The modem according to claim 40, wherein said LO frequency is 1952 MHz.

47. The modem according to claim 40, wherein said RF frequency is adapted to be in the 2.4 GHz Industrial Scientific Medial (ISM) band of frequencies.

48. The modem according to claim 40, wherein said pulse generator comprises a gating mechanism for gating said IF oscillator signal in accordance with input data to be transmitted.

49. The modem according to claim 40, further comprising a switching mechanism adapted to gate the output of said pulse generator and the output of said pulse spreader in an inverse relationship to each other, whereby when said pulse generator is enabled, said pulse spreader output is not and vice versa.

50. The modem according to claim 40, wherein said pulse spreader comprises second pulse shaping means operative to smooth the transitions of said spread pulse.

51. The modem according to claim 40, wherein said first pulse shaping circuit adapted to generate said pulse contour comprising a first portion that linearly ramps the amplitude of said pulse from a low to a high value and a second portion that linearly ramps the amplitude of said pulse from a high to a low value.

52. The modem according to claim 40, wherein said pulse spreader comprises a surface acoustic wave (SAW) matched filter.

53. The modem according to claim 40, wherein said spreading code sequence comprises a Barker code series sequence.

54. The modem according to claim 40, wherein said transmitter circuit comprises:
an IF amplifier for amplifying said spread pulse;
said upconverter for mixing said spread pulse with a LO signal;
an RF power amplifier for amplifying said spread spectrum transmission signal; and
an antenna coupled to the output of said output RF power amplifier.

55. The modem according to claim 40, wherein said receiver circuit comprises:
an antenna adapted to receive RF signals;
a first low noise amplifier (LNA) coupled to said antenna;

said downconverter for mixing said received signal with said LO oscillator signal; and a second low noise amplifier for amplifying the output of said downconverter.

56. The modem according to claim 40, wherein said correlator means comprises a surface acoustic wave (SAW) matched filter/correlator.

57. The modem according to claim 56, wherein said SAW matched filter/correlator is configured with a Barker code series sequence.

58. The modem according to claim 40, wherein said spreading means and said correlator means share a surface acoustic wave (SAW) correlator adapted to be used half duplex for transmission and receiving.

59. The modem according to claim 40, wherein said detector comprises:

a slow peak detector adapted to generate a slowly varying reference signal in accordance with said correlator signal;

a fast peak detector adapted to track the envelope of said correlator signal and to generate a detection signal therefrom; and

a decision circuit adapted to generate said output signal by comparing said detection signal against said reference signal.